INSTRUCTION NO. R9264
(Issue No. 1 of 10/57)

BRISTOL DRUM-TYPE PRECISION INDICATING STRAIN GAUGE

INSTRUMENT CENTER

RECORDING
INDICATING
CONTROLLING
TELEMETERING

INSTRUMENTS

BRISTOL'S

THE BRISTOL COMPANY
WATERBURY 20, CONN.

PLACE THESE INSTRUCTIONS WITH THE MAN IN CHARGE OF YOUR INSTRUMENTS

I M P O R T A N T

1. Read these instructions NOW before installing instrument.
2. Keep these instructions permanently & accessibly filed for future reference.
3. Be sure to specify MODEL & SERIAL numbers when ordering parts, instructions, diagrams or data.
4. Ship instruments or parts for repair or exchange only to Bristol's main or branch factories—not to Sales Offices.
5. Be sure to—
   1. Identify your shipments with your exact return address & order number.
   2. Write nearest Bristol Factory or office giving your order number, directions & address for return shipment, full instructions for repair, etc.
6. Report damage to shipments at once to shipping company. The *customer assumes responsibility for collecting any claim for damages* from the shipping company, on all shipments made on a collect basis.

WHO WILL SERVICE YOUR BRISTOL INSTRUMENT?

Divided responsibility produces misunderstanding and inattention. We therefore urge that all Bristol instruments in your plant be assigned to the care of one responsible man. He will rapidly become so familiar with routine chart changing, inking, checking and adjusting necessary to keep instruments in good working order, as to require only a few minutes time per day. Bristol will be pleased to supply additional information or personal instruction to instrument service men.

INSTRUCTION NO. R9264
(Issue No. 1 of 10/57)

BRISTOL DRUM-TYPE PRECISION INDICATING STRAIN GAUGE

Herewith: Instructions R9222, R9231 & P12072
Parts Lists P12077
Wiring Diagrams 011407A-C1, 016349, 013839

This instrument is a Bristol Drum-type Precision Indicator equipped with push buttons on the door of the case to provide a means of switching to any one of a number of strain gauge cells. When a push button is depressed, any previously pushed button will be released.

The standard Dynamaster instructions, included herewith, will apply except that all reference to the recording system should be ignored.

THE BRISTOL COMPANY
WATERBURY 20, CONN. U.S.A.

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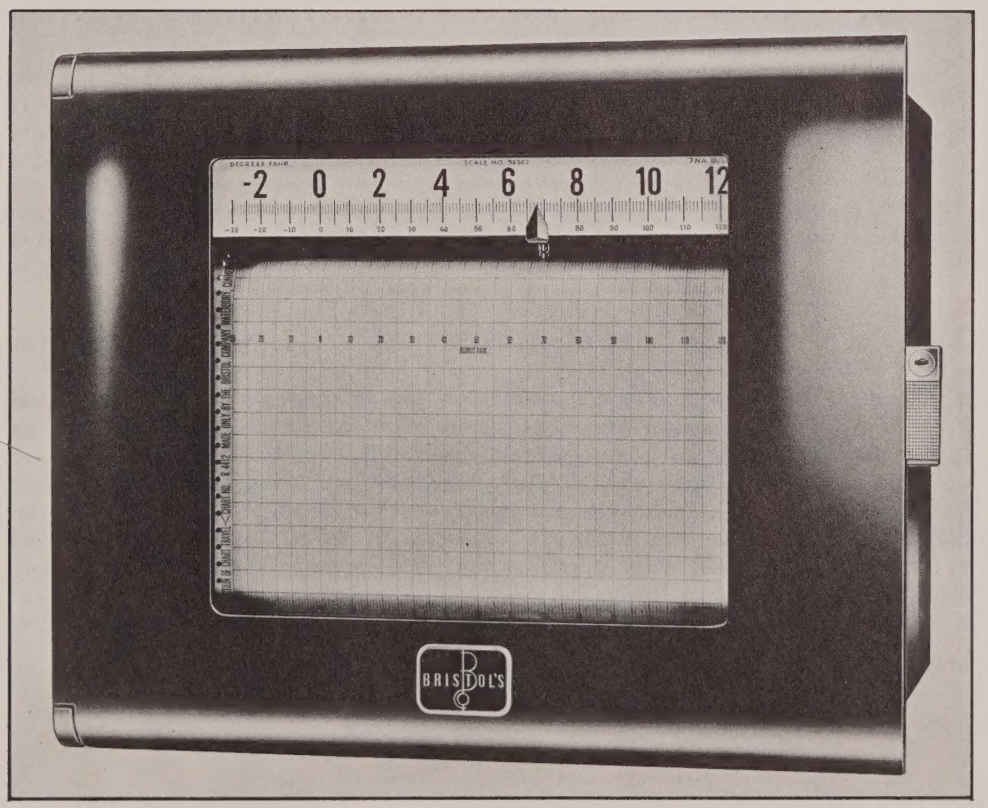
Instruction No. R9222
Issue of December 1963

INSTRUCTION NO. R9222

OPERATION AND SERVICE

BRISTOL'S MODEL 560 WIDE-STRIP DYNAMASTER A-C BRIDGE



THE BRISTOL COMPANY WATERBURY 20, CONN.

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Note: This instruction covers the basic balancing and amplifying systems in the Bristol Series 560 Single- and Multiple-point Wide-strip Dynamaster A-C Bridge-type Instrument. See separate instructions for case installation, recording system, measuring elements, controls, etc.

PART I GENERAL

A. Description

The Dynamaster a-c bridge is used with any resistance type of measuring element, such as a resistance-thermometer bulb, conductivity cell, strain gauge, etc.

A single variable is accurately measured and recorded as a line record on the chart of the single-pen recorder. As many as 16 variables may be recorded on the chart of the multiple-point recorders.

The major components of the instrument are:

1. The bridge circuit
2. The amplifier
3. The balancing motor
4. The recording system
5. The multiple-point switching system (used only in the multiple-point recorders)

B. Explanation of Operation

The measuring element forms one leg of the a-c bridge (Wheatstone bridge). When its resistance changes, current flows in the bridge and a voltage unbalance (error signal) is created. This error signal is fed into the amplifier and amplified to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slide wire to restore electrical balance in the bridge circuit and simultaneously moves the indicating pointer and pen or print wheel to indicate and record, on the scale or chart, the value of the variable being measured.

This balancing action starts immediately with the slightest change in the resistance of the measuring element. Thus, recording and indicating of the measured quantity are practically instantaneous.

When balance has been restored, the entire bridge remains at rest until another change in the measured variable occurs.

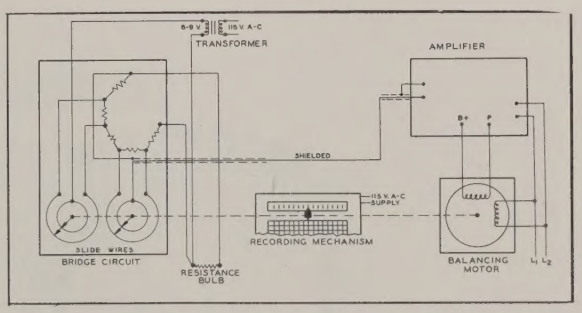


FIGURE 2. SIMPLIFIED SCHEMATIC WIRING DIAGRAM OF DYNAMASTER A-C BRIDGE

PART II OPERATION

A. Starting the Dynamaster

To start the Dynamaster after it has been completely and correctly wired, simply turn on the instrument on-off switch. Nothing further need be done. If your Dynamaster is equipped with a control unit or other accessory, see separate instructions provided for its operation.

B. Stopping the Dynamaster

To stop the Dynamaster, merely turn off the instrument on-off switch. For a prolonged shutdown, the instrument should be stored in a clean, dry place.

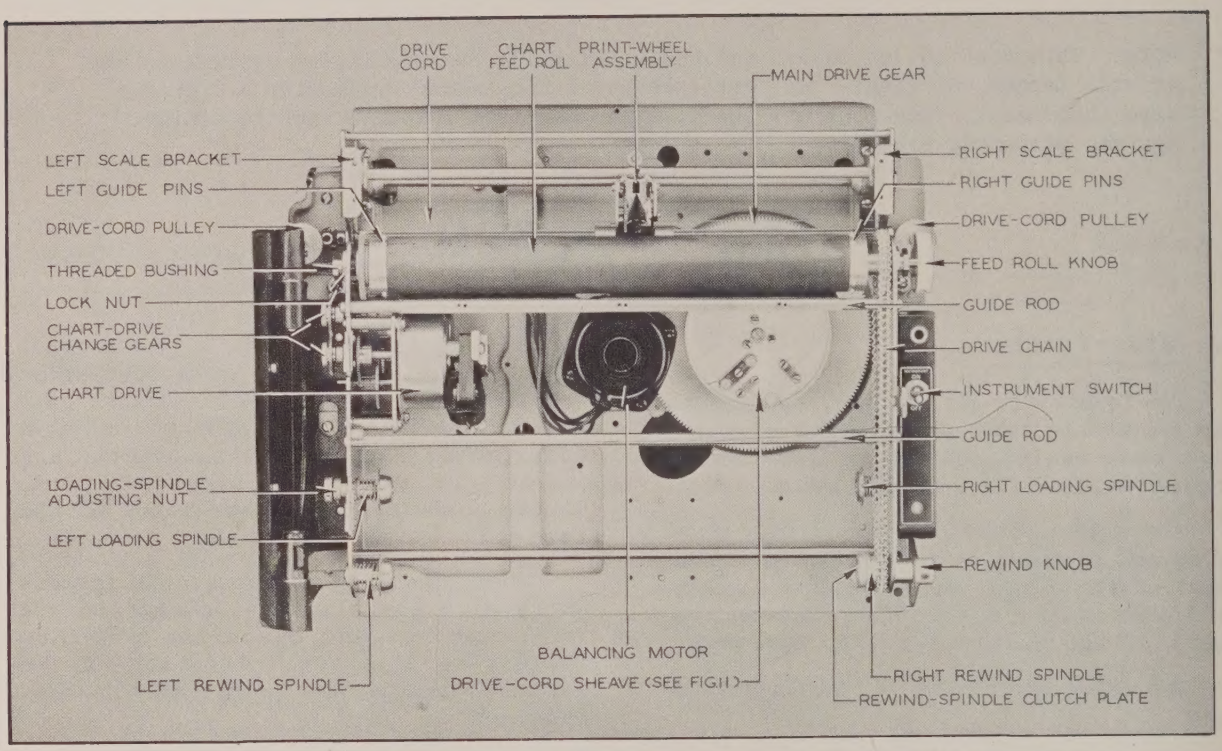


FIGURE 3. FRONT OF PANEL, MULTIPLE-POINT DYNAMASTER A-C BRIDGE

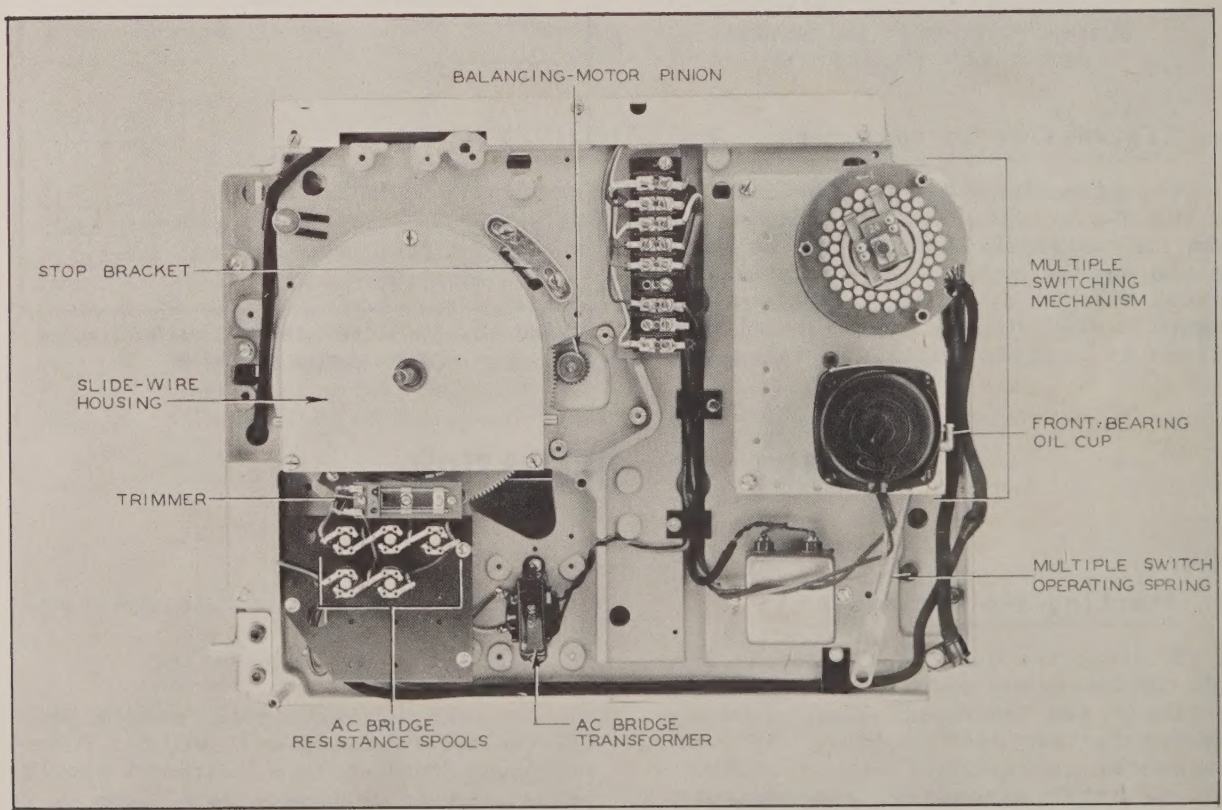


FIGURE 4. BACK OF PANEL, MULTIPLE-POINT DYNAMASTER A-C BRIDGE

C. Amplifier Gain Adjustment

1. On Single- and Two-pen Recorders. The only time the amplifier gain adjustment need be checked is after changing tubes or doing other service work on the amplifier, and about once every 3 to 6 months thereafter. The reason for the periodic check is because the vacuum tubes age with use. While this check is being made, the measured variable should be at a steady value.

To check the amplifier gain, proceed as follows:

Allow amplifier to warm up for at least 2 minutes. Remove the cap on the gain adjusting screw (see Figure 6 or 8). Turn the balancing-motor pinion (drive gear) manually to the right and release it. The pen should return quickly to its original position each time. If it does not return to its original position completely and quickly, it indicates that the amplifier gain (or sensitivity) is too low. To increase the gain, turn gain adjusting screw in a clockwise direction. When the gain adjustment has reached its maximum clockwise direction, the amplifier lacks sensitivity and requires new tubes.

There is an optimum position for the gain control. If the gain is too low, the pen will not return quickly to its proper value when the balancing motor is manually shifted off balance. If the gain is too high, the pen may "hunt" (mechanical oscillation of the pen). On some instruments if an abnormal pickup in the external measuring circuit is present, it is possible to turn the gain high enough to overload the amplifier and cause the balancing motor to act sluggishly. This condition can be corrected by reducing the gain (turning gain adjustment counterclockwise).

2. On Multiple-point Recorders. The gain adjustment on multiple-point recorders is made in the same manner as on single-pen recorders except that the motor on the multiple-switching mechanism must be stopped during this adjustment.

Present instruments are provided with a switch, mounted on the left side of the switching mechanism, to cut the power to the switching motor.

On instruments without a switch, the power may be broken by disconnecting the gray lead from the switching motor. Be sure to turn off the instrument power supply before disconnecting this lead.

PART III SERVICE

Service to the Bristol Dynamaster requires complete familiarity with the instrument. Other than routine preventive maintenance should be done only by a qualified technician, or the instrument should be returned to The Bristol Company for service. For routine maintenance on the instrument see Instruction No. Y19820.

A. Suggested Service Equipment

1. Stock of Replacement Parts. It is suggested that the following replacement parts be kept in stock. The vacuum tubes listed below are standard types and are available at any radio supply store:

Type 6X5 rectifier tube

Type 6V6 power amplifier tube

Type 7F7 voltage amplifier tube

Plug-in type electrolytic filter capacitor with octal base (10-10-10 mfd. 450 volt) **Note:** Electrolytic capacitors deteriorate in storage. Their shelf life should not be over 18 months. Replacement electrolytic capacitors can be kept in usable condition indefinitely by placing them in service in the Dynamaster for an hour or two every six months.

Fuses for amplifier (1-ampere Littlefuse for Series C amplifier. 1/8 ampere Littlefuse for Series C-1 or C-2 amplifier).

Amplifier. Where several Dynamasters are in use or where continuous instrument performance is of critical importance, it is recommended that spare replacement amplifiers be kept in stock.

Glass pen for single-pen recorders

Glass pens for two-pen recorders

Inked felts for multiple -point recorders

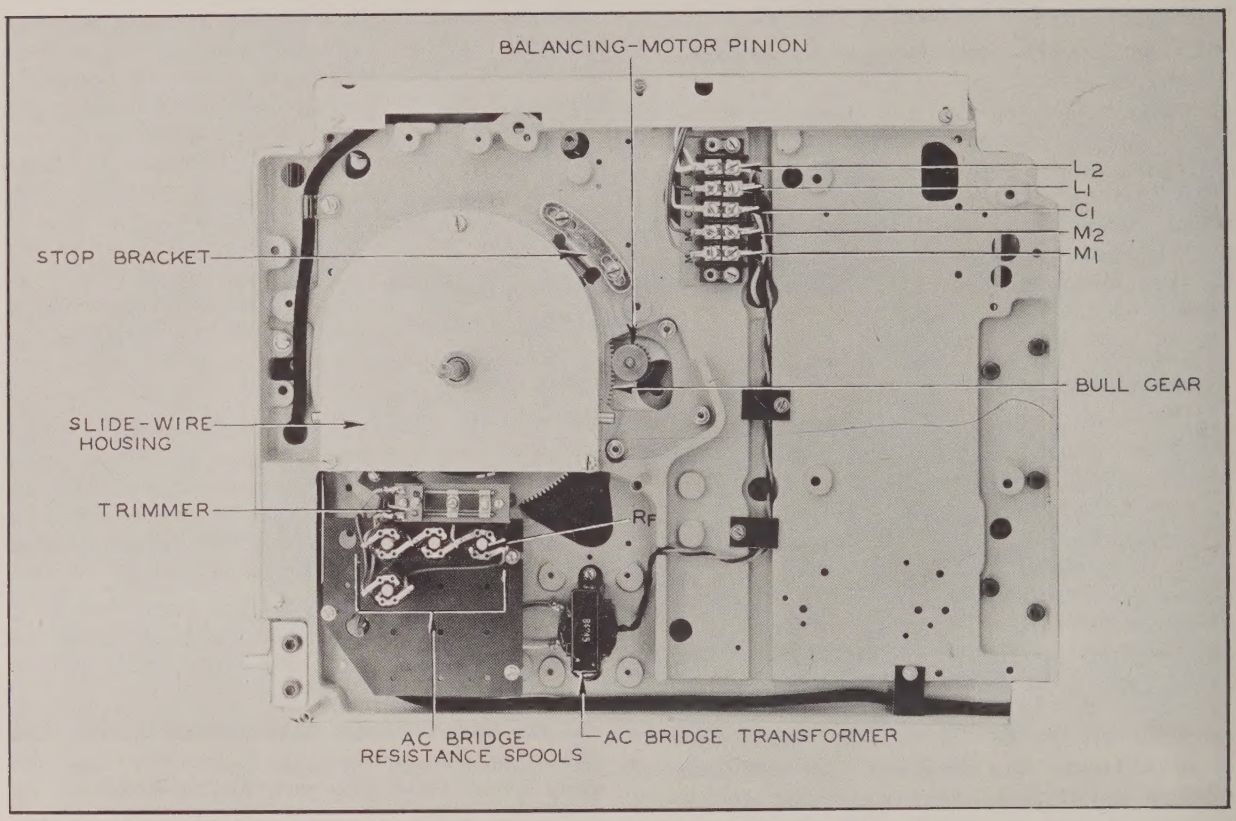


FIGURE 5. BACK OF PANEL, SINGLE-POINT DYNAMASTER A-C BRIDGE

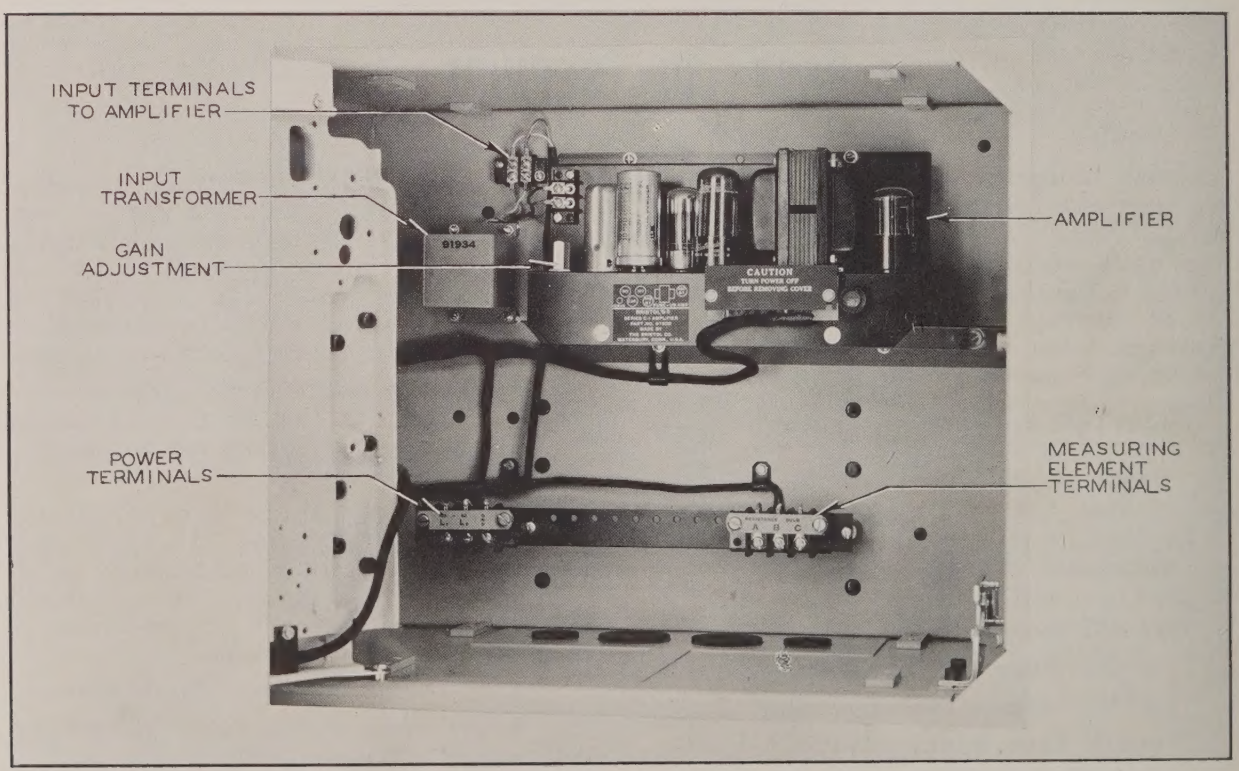


FIGURE 6. INTERIOR OF CASE

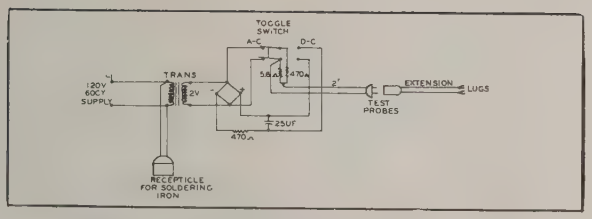


FIGURE 7. WIRING DIAGRAM OF TEST INPUT-SIGNAL GENERATOR

2. Test Equipment

A **test input-signal generator** (Fig. 7) is a must for all service men as it provides a quick means of isolating the faulty unit in the detection section of the instrument. This input-signal generator may be easily made by the user or may be purchased from the Bristol Company. Order Bristol's Part Number C-1038.

An **a-c voltmeter** or **test lamp** is required to perform the power-supply check.

An **ohmmeter** is convenient when checking the continuity of the measuring system.

A set of **test resistance spools** is handy for checking resistance measuring instruments. The Bristol Company manufactures a set of very accurate test resistance spools. Spools may be ordered by the set or singly for any value. Ordinary variations in room temperature do not affect their accuracy.

B. Systematic Trouble-shooting Procedure

Should the Dynamaster fail in any way, it is first necessary to determine which part is faulty. The following systematic procedure is suggested in order that repairs may be accomplished with a minimum of lost time and expense.

1. Power-supply Check. Using a 150-volt-range a-c voltmeter (or test lamp), check for line voltage across instrument power terminals, instrument power switch, L_1 and L_2 terminals on back of swinging panel, and also L_1 and L_2 terminals on amplifier.

2. Balancing-motor Check

Caution: Always be sure to turn power switch off before shifting the two control-winding wires because of the high voltage (300 volts) across terminals M_1 M_2.

a. On instruments with the Series C amplifier. Turn power switch off. Remove the two control-winding wires at terminals M_1 and M_2 (Fig. 6) and then put these wires across terminals L_1 and L_2 on the same terminal block. Turn on power switch. The motor should move the pen up or downscale (depending upon phase). Next, reverse these wires from the control winding. The motor should move the pen in the opposite direction. If the balancing motor fails to move the pen up or downscale with the above tests, it could mean that one of the following conditions exists:

1. No power to balancing motor.
2. Balancing motor defective.
3. Mechanical failure between balancing-motor pinion, bull gear and recording-pen shaft.

b. On instruments with the Series C-1 or C-2 amplifier. Turn off power switch. Remove the two control-winding wires from terminals M_1 and M_2. Connect these wires across terminals L_1 and L_2 with a 1-microfarad capacitor in series with one of the wires. Turn on power switch. The motor should move the pen up or downscale (depending upon phase). Next, reverse these wires from the control winding. The motor should move the pen in the opposite direction. If the balancing motor fails to move the pen up or downscale with the above test, it could mean that one of the following conditions exists:

1. No power to balancing motor.
2. Balancing motor defective.
3. Mechanical failure between balancing-motor pinion, bull gear and recording-pen shaft.

3. The Amplifier. Plug Dynaprobe into terminal block and apply test prongs across the input terminals of the amplifier (see Fig. 8). If amplifier is working properly, the balancing motor will move the pen up or downscale (depending upon phase). Reversing the two test prongs will cause the balancing motor to move the pen in the opposite direction. If the balancing motor does not move the

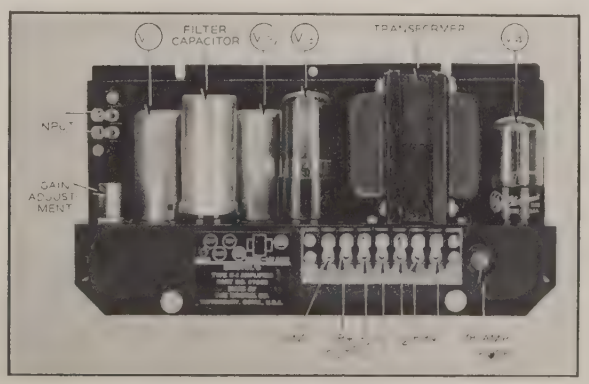


FIGURE 8. SERIES C-1 OR C-2 AMPLIFIER

pen up or downscale, disconnect the input leads to amplifier and check again with the test prongs across input terminals to amplifier. If the balancing motor still does not move the pen up or downscale, check fuse in amplifier, replace vacuum tubes and filter capacitor in amplifier. If this does not work, replace the amplifier.

Note: The Bristol Company recommends that service work inside the amplifier chassis should not be attempted by the average user. Service work on electronic circuits is a specialized technique requiring special test equipment for efficient results. For users having available an electronic technician and adequate test facilities, The Bristol Co. has prepared service instructions for the amplifier which contain a detailed circuit diagram, testing data and procedure for checking the amplifier. A copy of this instruction is furnished with each Dynamaster.

4. The Measuring System. From the simplified schematic diagram (Fig. 2) it will be noted that the measuring element is wired so as to form one leg of the bridge. An open circuit anywhere in the bridge will produce an infinite resistance, driving the pen or print wheel to the top or bottom of the chart depending upon what portion of the bridge is open-circuited. If an open circuit is suspected, it can easily be checked with an ohmmeter. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

a. Check for voltage on secondary winding of bridge transformer (8 to 9 volts).

b. Check to see that the sliding contact (Fig. 9) makes good contact with the slide-wire. Try cleaning slide-wire with Bristol cleaning fluid or other solvent. Allow to dry. Then apply a small amount of Cramolin to slide-wire and wipe off excess with a clean cloth.

Caution: If any solvent other than Bristol's cleaning fluid is used to clean slide-wire, it must be a type that will not leave a residue or one that will not attack varnish.

If all of the above checks have been performed and the instrument still fails

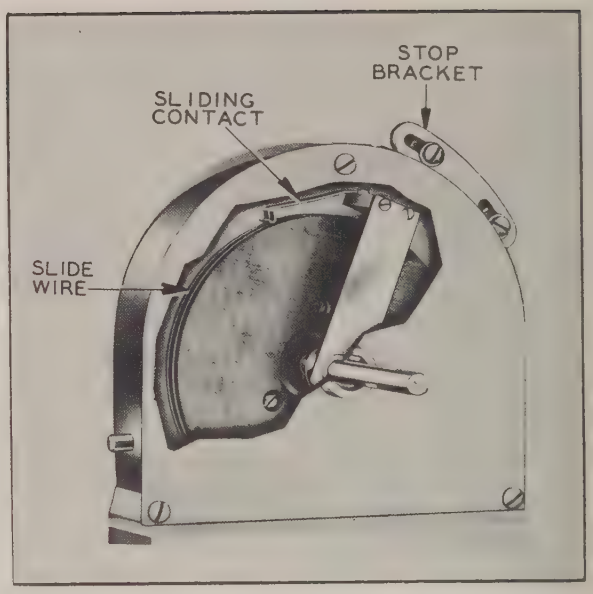


FIGURE 9. CUTAWAY VIEW OF SLIDE-WIRE HOUSING

to function, the possible fault may be either an open circuit or a short circuit somewhere in the measuring system. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

5. The Recording System. The recording system is mechanical. It includes the chart drive and its gear train, chart feed roll, pen or print-wheel assembly, pen or print-wheel drive cord and pulleys, etc.

Check the recording system for mechanical troubles, such as loose or binding gears, pulleys and fittings, etc. Move the pen or print wheel up and downscale manually by turning the main drive gear (with power off). It should move freely from one end of the scale to the other.

Feed the chart manually by turning the feed-roll knob counterclockwise. The tension of the feed-roll clutch should be felt, but the chart should feed straight and smooth without tearing or distorting the holes. The pen or print wheel should make a clean, legible record.

See also separate instructions on the servicing of the recorder system.

6. The Switching Mechanism. The automatic mechanism (see Fig. 4) which provides the necessary mechanical power for printing in the multiple-point Dynamaster as well as the sequential selection of all the primary measuring elements has been carefully designed and manufactured for long and continuous use. Occasionally it may be necessary to increase the

multiple-switch operating-spring tension. The need for this will be indicated by indiscriminate or random printing of some or all of the records on the chart. To increase the spring tension, move the spring adjusting link to the next hole.

C. Miscellaneous Trouble-shooting Tips

In general, the following symptons of troubles described below are caused by definite faults.

For all failures not specifically described below, follow the systematic trouble-shooting procedure outlined in Paragraph B, page 7.

1. Symptom: Pen or print wheel remains stationary regardless of changes in the value of the measured variable. **Possible faults:**

a. Defective line fuses
b. Power failure
c. Defective amplifier fuse. An amplifier fuse which burns out repeatedly generally indicates a bad rectifier tube or filter capacitor (plug-in capacitor).
d. Defective tube in amplifier
e. Defective filter capacitor
f. Open circuit in measuring element
g. Defective balancing motor

2. Symptom: Pen or print wheel records incorrect values. **Possible faults:**

a. Defective measuring element
b. Insufficient multiple-switch operating-spring tension
c. Incorrect gain adjustment

3. Symptom: Chart does not feed properly. **Possible faults:**

a. Chart is not lined up properly.
b. Feed-roll clutch is slipping.

4. Symptom: CHart speed is incorrect. **Possible faults:**

a. Wrong change gears
b. Defective motor
c. Frequency of power supply incorrect

D. Repairs, Correspondence and Shipping

If the Dynamaster cannot be repaired with the information furnished in this instruction, it should be shipped to the nearest Company Branch or Main Factory for repair or replacement. Do not ship instruments to Branch Offices. Be sure to mark your return address plainly.

In all correspondence please mention the instrument model and serial number (as listed on its nameplate) and your repair order number. Address all correspondence to the Bristol Company Branch or Main Offices, a list of which is found in all instruction manuals.

The Bristol Company
Waterbury 20, Connecticut

Printed in U. S. A.

INSTRUCTION NO. R9231
(Issue No. 1 of 3/55)

SPECIAL ADJUSTMENTS FOR BRISTOL'S SERIES 560 A-C DYNAMASTER STRAIN GAUGES

A. Span Adjustment

a. Standard. Unless otherwise specified, all Dynamasters are provided with a 5-ohm stick resistor located near the supply transformer. This resistor provides a means for field adjustment to compensate for changes in lead length (± 100 feet) from that for which the instrument is calibrated. This adjustment can be made as follows: with the strain gauge at a known value, preferably near the top of the scale range, adjust stick resistor until instrument reads correctly.

b. Additional adjustment. When range changing as well as lead length adjustment is needed, a rheostat is installed in the upper right-hand corner of the hinged panel. Two rheostats are offered: one a single turn wire-wound potentiometer to permit up to 30% span adjustment and second a multi-turn potentiometer to permit above 30% span adjustment. This adjustment should be made with the strain gauge at a known value, preferably near the top of the scale range. Adjust potentiometer until instrument reads correctly.

B. Zero Adjustment

A zero adjustment is provided as an optional feature to permit setting the zero after initial loading is put on the strain gauge. This adjustment is located on the spool card.

C. Capacity Adjustment

The capacity adjustment is located on the spool card and may be adjusted by one of the following methods:

1. Turn the gain of the amplifier up until the system starts to oscillate. Adjust capacity adjustment so as to increase oscillation. Reduce the gain to the verge of oscillation. Adjust capacity adjustment to increase oscillation. Continue this procedure to the point of maximum oscillation for minimum gain. The capacity adjustment should then be covered and left alone. The gain of the amplifier may then be adjusted as per standard Dynamaster instructions. If the range of the instrument is such that it will not oscillate, go through the above procedure for maximum sensitivity for minimum gain, where sensitivity is defined as minimum dead band. This condition can be checked by either moving the bull gear by hand or moving the motor pinion by hand while the instrument is energized.

2. If there is a high impedance voltmeter available an alternate method of adjusting is as follows: connect the leads "with a series capacitor" of a high impedance rectifier type meter from the plate (blue wire at the motor terminal block on the panel) to ground and adjust the capacity adjustment for minimum voltage. If the meter has "output" terminals, these may be used without the series capacitor. A vacuum tube voltmeter may also be used.

3. A third method would be to connect an oscilloscope from plate to ground and adjust for minimum scope picture.

THE BRISTOL COMPANY
WATERBURY 20, CONNECTICUT, U.S.A.

INSTRUCTION NO. P12072

(Replaces issue of 9/61)

SERVICE INSTRUCTIONS

FOR THE SERIES C-1, C-3 & C-4 AMPLIFIERS

PART I INTRODUCTION

This instruction covers the service of the Series C-1, C-3 and C-4 amplifiers used on Bristol Dynamaster (Models 560, 565 etc.). The Series C-1 amplifier is for use of a 120 v. 60 cy. supply. The Series C-3 is for use on a 120 v. 60 cy. supply and a Dynamaster with attachment T100 (auxiliary gain adjustment). The Series C-4 amplifier is for use on a 120 volt, 50 cy. supply.

Service work on electronic circuits is a specialized technique requiring special test equipment. Only a qualified electronic technician should attempt service inside the amplifier chassis. If a qualified technician is not available, the amplifier should be returned to the nearest Bristol Company Branch or Main Factory for repair. Adequate stocks of guaranteed, factory-rebuilt exchange amplifiers are maintained at several points throughout the country to assure fast replacement. Contact nearest Bristol office as listed on last page of all instruction books.

PART II TEST EQUIPMENT

Multirange volt-ohmmeter with ranges 0 to 50 and 0 to 500 volts d-c, 0 to 4000 and 0 to 500,000 ohms resistance, voltage sensitivity 20,000 ohms per volt.

A signal generator, such as Bristol's Dynaprobe Part No. C1038, is recommended for producing a test input signal. Figure 1 illustrates how a signal generator can be made.

Cathode-ray oscilloscope with an input impedance not less than 500,000 ohms and a vertical sensitivity of .03 volts.

PART III TEST PROCEDURE

Disconnect all leads to amplifier and remove amplifier from Dynamaster. The amplifier may be removed by loosening the rear mounting screws and unlocking the quick fasteners on the front of the chassis.

Connect a 5000-ohm 10-watt resistor across the output terminals of the amplifier.

Caution: Never check an amplifier without first connecting the 5000-ohm resistor across the output terminals of the amplifier.

Connect the 120-volt power supply to power terminals marked L_1 and L_2. This

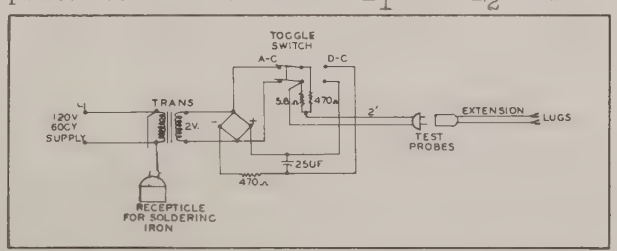


FIGURE 1. WIRING OF TEST INPUT-SIGNAL GENERATOR

Measure		Correct	Recommended Correction	
From	To	Voltage	If Voltage Is Too Low	If Voltage Is Too High
B+	Gnd.	360 ± 36	Replace V_4 & plug-in capacitor No voltage. Replace fuse.	Replace V_3
B_5	Gnd.	355 ± 35	Replace plug-in capacitor	Replace V_3
B_4	Gnd.	330 ± 33	Replace plug-in capacitor	Replace V_1 or V_2
B_3	Gnd.	260 ± 26	Replace plug-in capacitor	Replace V_1 or V_2
S_c	Gnd.	335 ± 33	Replace V_3	Replace V_3 Check R_{23}
B_{1-2}	Gnd.	220 ± 22	Replace plug-in capacitor Check C_{21}	Replace V_1
P_5	Gnd.	240 ± 24	Check voltage at B_5	Replace V_3
P_4	Gnd.	290 ± 30	Check voltage at K_4	Check R_{19}
P_3	Gnd.	145 ± 14	Check voltage at K_3	Check R_{15}
P_2	Gnd.	115 ± 10	Check voltage at K_2	Check R_7
P_1	Gnd.	115 ± 10	Check voltage at K_1	Check R_3
K_5	Gnd.	24 ± 3	Check C_{16}	Check R_{23}
K_4	Gnd.	4.8 to 5.7	Check C_{13} & R_{19}	Check R_{18}
K_3	Gnd.	2.3 ± 0.5	Check C_{10}	Check R_{14}
K_2	Gnd.	1.8 ± 0.5	Check C_4	Check R_6
K_1	Gnd.	1.8 ± 0.5	Check C_1	Check R_2
Note: Points K_1, K_2, etc., were marked C_1, C_2, etc., on earlier models.				

FIGURE 2. TABLE OF D-C VOLTAGE CHECKS BASED ON A LINE VOLTAGE OF 117 VOLTS AND A 5000-OHM 10 WATT RESISTOR ACROSS THE OUTPUT TERMINALS OF AMPLIFIER

is the nominal operating voltage and any variation from it will produce slightly lower or higher test readings.

Warning: There are dangerous voltages in the amplifier. Never touch any part with bare hands unless the power is off.

A. D-C Voltmeter Check

A quick method of locating the defective stage is by the use of a d-c voltmeter.

With the amplifier removed from the instrument, proceed as follows:

1. Connect a 5000-ohm 10-watt resistor across the output terminals of the amplifier.

2. Connect the 120-volt supply to power terminals (L_1 and L_2).

3. Turn gain control to zero (extreme counterclockwise position).

4. Connect negative lead of voltmeter to the ground connection on the amplifier. Test with the other voltmeter lead at the points listed in table, Figure 2.

The voltages given in the table (Figure 2) were taken with a 20,000 ohm per volt meter and with a line voltage of 117 volts. If the line voltage is greater or less than 117 volts, the d-c voltage given in the voltage table will vary proportionally. **For example:** If the line voltage is 110 volts, the B+ voltage instead of being approximately 360 volts will be $\frac{110}{117} = \frac{x}{360}$ or $x = \frac{110 \times 360}{117} = 338.$

Therefore, the B+ voltage will be approximately 338 volts with a line voltage of 110 volts.

For optimum damping and sensitivity, the voltage between K_4 and ground should not vary more than specified values.

All d-c voltages above 100 volts should not vary more than ± 10% from specified values.

Voltages between K_1, K_2 and K_3 and ground should not vary more than ±0.5 volts from specified values.

Voltage between K_5 and ground should not vary more than ±3 volts from specified value.

If B+ is low, replace V_4. If B_3, B_4 or B_5 is low, replace the plug-in filter capacitor with one known to be good. This capacitor contains C_{18}, C_{19} and C_{20}.

B. Testing with an Oscilloscope

For those who desire to locate the defective stage by tracing a test input signal step by step thru the amplifier with an oscilloscope, the following procedure should be followed:

1. Connect a 5000-ohm 10-watt resistor across the output terminals of the amplifier.

2. Connect the 120-volt supply to power terminals (L_1 and L_2).

3. Connect the a-c test input signal from the signal generator to the amplifier input terminals.

4. Turn the gain adjustment to its maximum position (extreme clockwise position).

5. Connect the ground side of the oscilloscope to the amplifier chassis ground.

6. Connect test voltage to the vertical input terminals (Y axis) of the oscilloscope. Then, adjust horizontal sweep rate, as required, until a sine-wave pattern appears on the scope. See also directions furnished with oscilloscope.

(G_1) **Signal:** Sine wave on screen. Note amplitude for comparison with the following tests.
No Signal: Check signal generator.

(P_1) **Signal:** Amplitude should be about 40 times G_1.
No Signal: Defect in first stage. Check V_1. Check voltage from K_1 to ground and P_1 to ground (see d-c voltage table, Figure 2).

(X_1) **Signal:** Same as P_1.
No Signal: Check C_2 and R_4.

(G_2) **Signal:** Slightly less than P_1.
No Signal: Check C_3, R_4 and R_5.

(P_2) **Signal:** Amplitude should be about 40 times greater than G_2.
No Signal: Defect in second stage. Check V_1. Check voltage from K_2 to ground and P_2 to ground (see d-c voltage table, Figure 2).

Next, reduce gain until setting on oscilloscope and picture approach original at G_1. Note amplitude for comparison with following test.

(X_2) **Signal:** Amplitude about 1/5 that of P_2. If signal is abnormally high or low, check R_8, R_9, R_{10}, C_5, C_6, C_7 and R_{11}. If fault is found in this section, replace entire board or return amplifier to factory.

(X_3) **Signal:** Same as X_2.
No Signal: Check C_8 and R_{12}.

(G_3) **Signal:** Amplitude should be about the same as X_3.
No Signal: Check C_9 and R_{13}.

(P_3) **Signal:** Amplitude should be about 50 times G_3.
No Signal: Defect in third stage. Check V_2. Check voltage from K_3 to ground and P_3 to ground (see d-c voltage table, Figure 2).

(X_4) **Signal:** Same as P_3.
No Signal: Check C_{11} and R_{16}.

(G_4) **Signal:** Less than X_4.
No Signal: Check C_{12} and R_{17}.

Next, reduce gain until setting on oscilloscope and picture approach original at G_1. Note amplitude for comparison with following test.

(P_4) **Signal:** Amplitude should be about 14 times G_4.
No Signal: Defect in fourth stage. Check V_2. Check voltage from K_4 to ground and P_4 to ground (see d-c voltage table, Figure 2).

(G_5) **Signal:** Approximately 1/4 that of P_4
No Signal: Check C_{14}, C_{15} and R_{21}.

(X_5) **Signal:** Same as G_5.
No Signal: Check R_{22}.

(P_5) **Signal:** Amplitude should be about 6 times G_5.
No Signal: Defect in fifth stage. Check V_3. Check voltage from K_5 to ground and P_5 to ground (see d-c voltage table, Figure 2).

(P) On terminal strip
Signal: Same as P_5.
No Signal: Check connections between P and P_5.

C. Identifying Defective Part

When the defective stage is located from the above checks, the defective part of that stage may be identified. This is

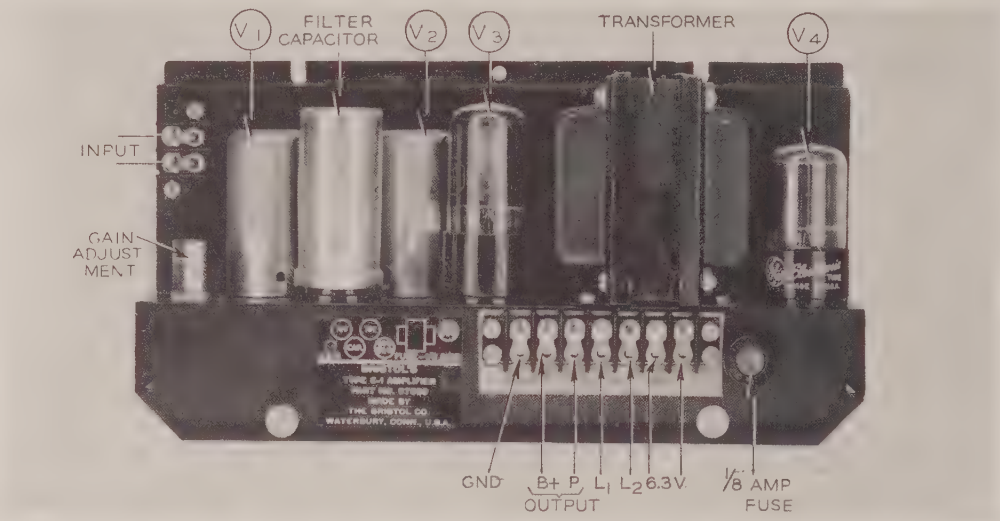


FIGURE 3. FRONT VIEW OF SERIES C-1 AMPLIFIER

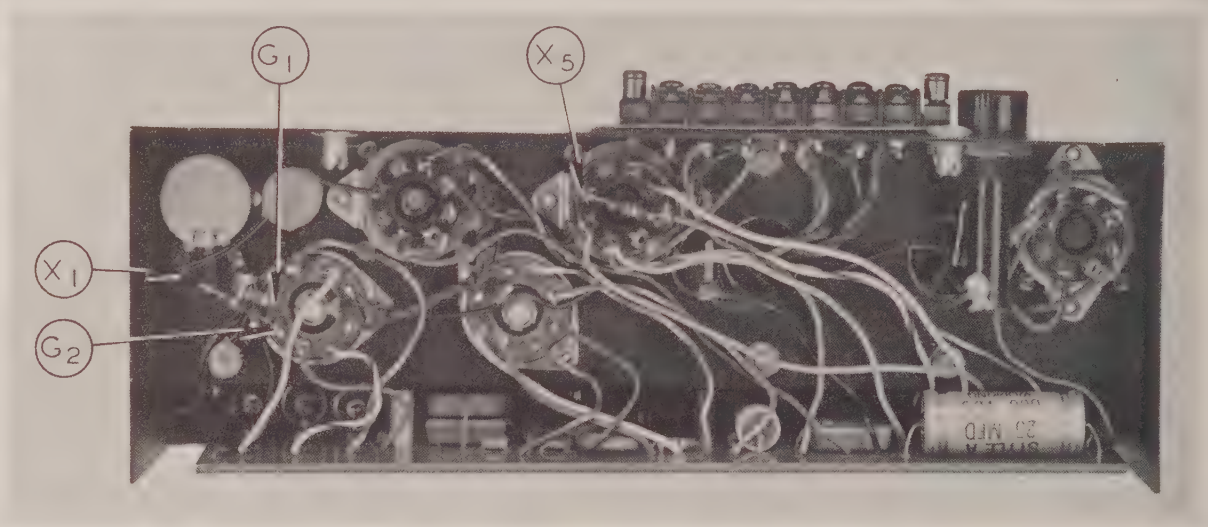


FIGURE 4. BOTTOM VIEW OF SERIES C-1 AMPLIFIER

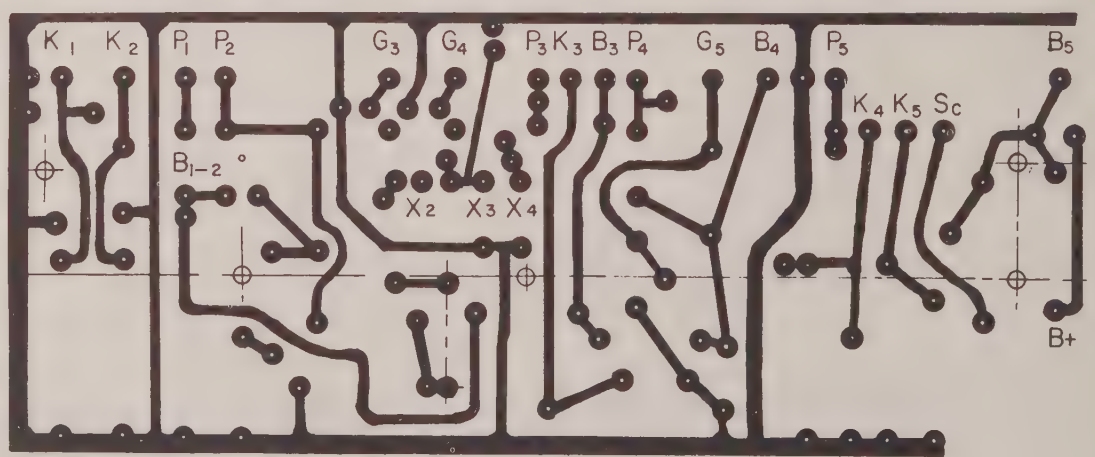


FIGURE 5. PRINTED CIRCUIT SHOWING TEST POINTS

done by checking with an ohmmeter the resistors of that stage. All ohmmeter checks should be made with the power off and the plug-in capacitor and vacuum tubes removed. If the resistors are correct, it can generally be assumed that a capacitor or capacitors associated with that section of the circuit are defective. Test them by replacement.

This systematic checking of each resistor and capacitor in the defective stage will quickly identify the defective part.

D. Calibration of Printed Circuit Board for Series C-1 and C-3 Amplifiers.

The printed circuit board contains 2 calibrating resistors, identified as R9 and R29 on the schematic drawings.

These resistors are part of a double T network designed to suppress any 120 cycle signal. The network is tuned at the factory and should never require any field attention. If the capacitors and resistors in this network are damaged in the field, we would recommend purchasing a printed circuit board complete with the components shown in figure 6.

If it is necessary to change one of the resistors or capacitors in this network in the field, it will be necessary to retune the network. To do this requires a 120 cycle oscillator, a sensitive a-c voltmeter or oscilloscope and 2 decade resistor boxes.

Connect the oscillator between P2 and ground. Set the oscillator at 120 cycles and apply 10 volts. **Caution:** Be sure that the amplifier is disconnected from the power lines at this time. Connect the sensitive a-c voltmeter or oscilloscope between X2 and ground. Connect a decade resistor box in place of R9 (10,000 to 150,000 ohms) and another in place of R29 (1000 to 15,000 ohms). Adjust resistors R9 and R29 until a minimum reading is obtained on the oscilloscope or meter. The suppression of 120 cycles in this filter should be between 300 and 1,000 to 1. This means that with a 10-volt input from the oscillator you should be able to reduce that signal to 33 mv. or less.

When the proper values for R9 and R29 are determined, obtain resistors of this value and install. These resistors should be wire wound with a tolerance of ± 10%.

NOTE: For series C-4 (50 cy.) amplifiers, the calibration is the same as above except that references to 120 cycles should be changed to 100 cycles.

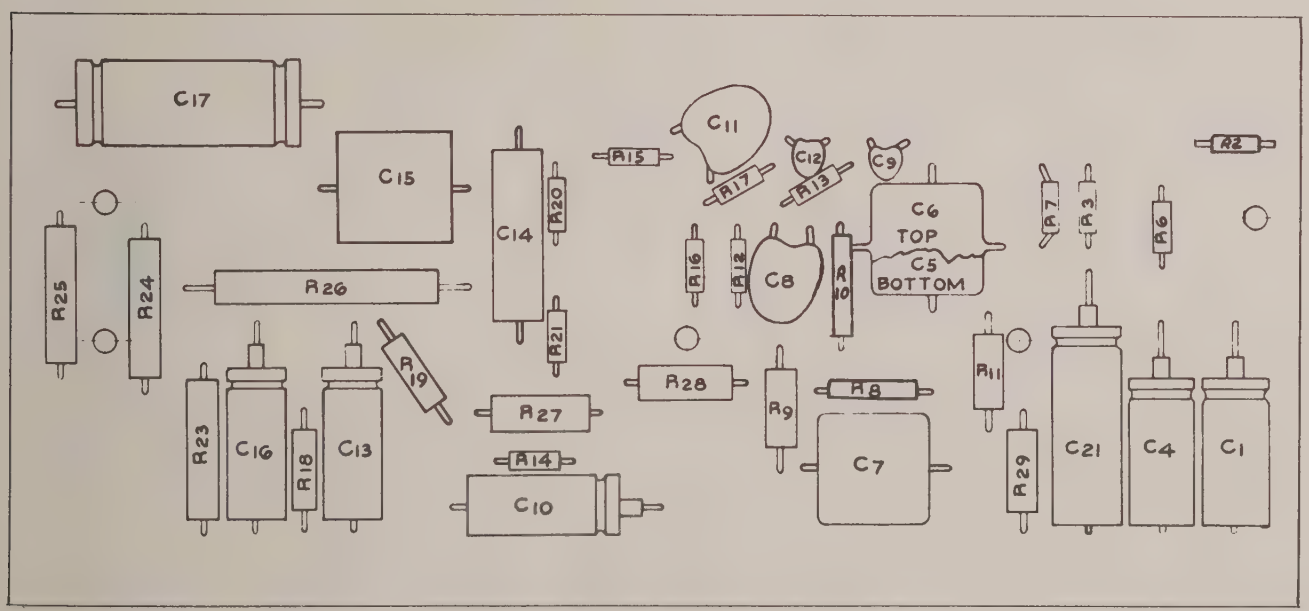


FIGURE 6. COMPONENT SIDE OF PRINTED CIRCUIT BOARD

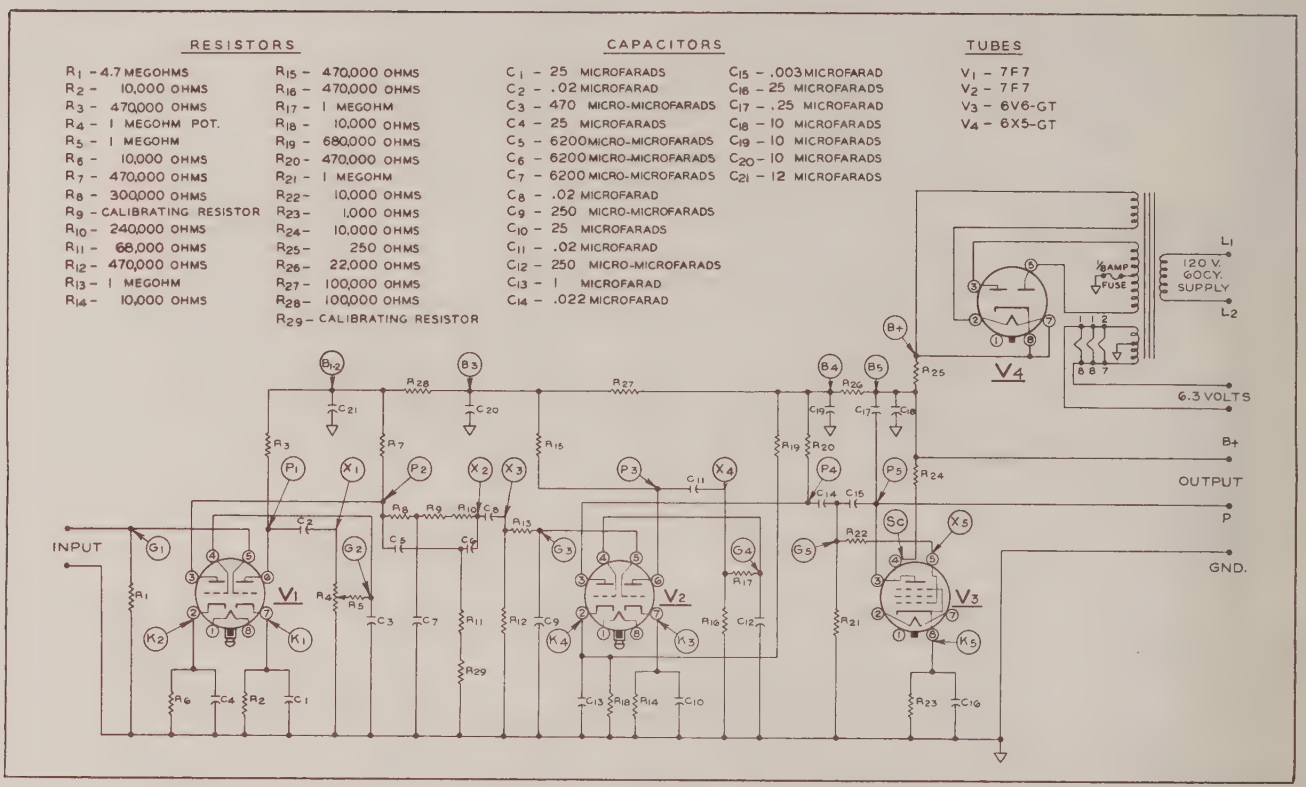


FIGURE 7. SCHEMATIC WIRING DIAGRAM SERIES C-1 AMPLIFIER

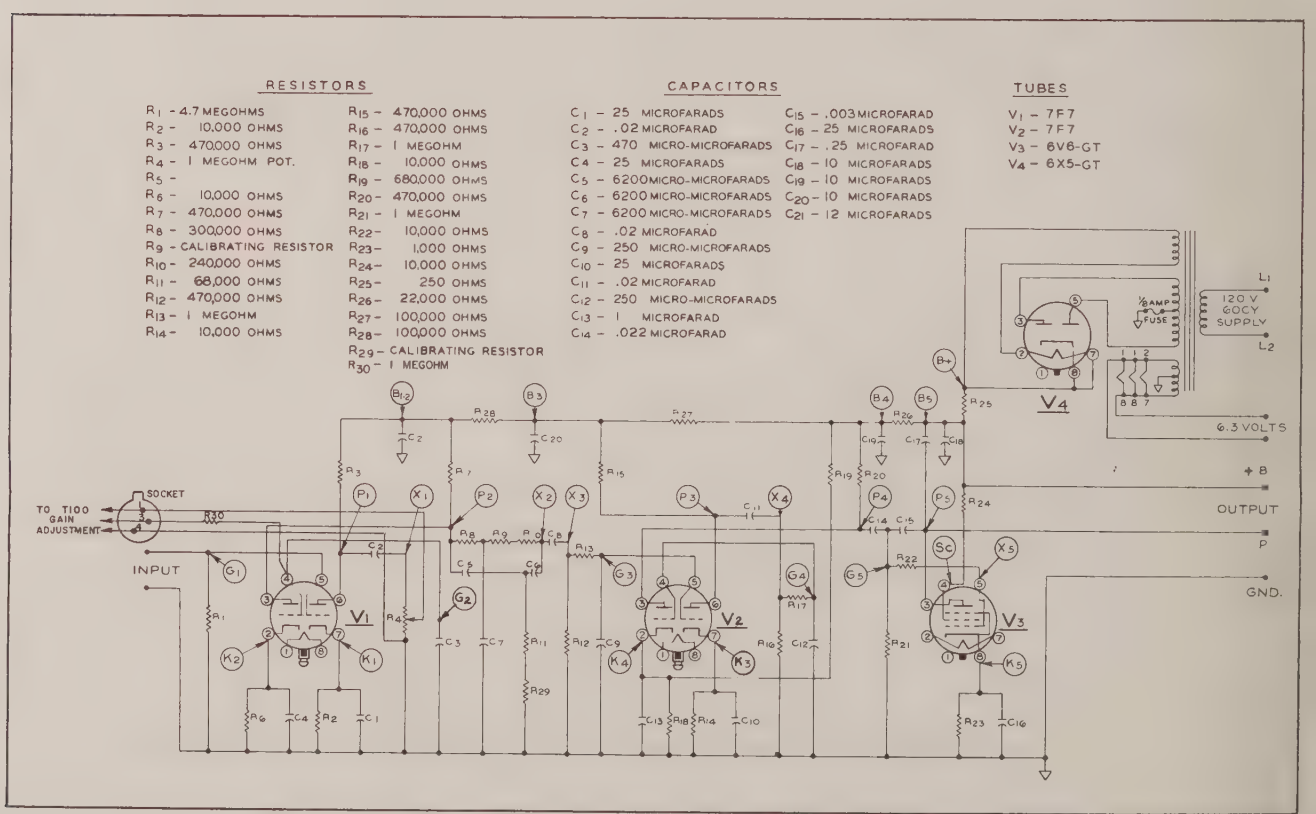


FIGURE 8. SCHEMATIC WIRING OF SERIES C-3 AMPLIFIER

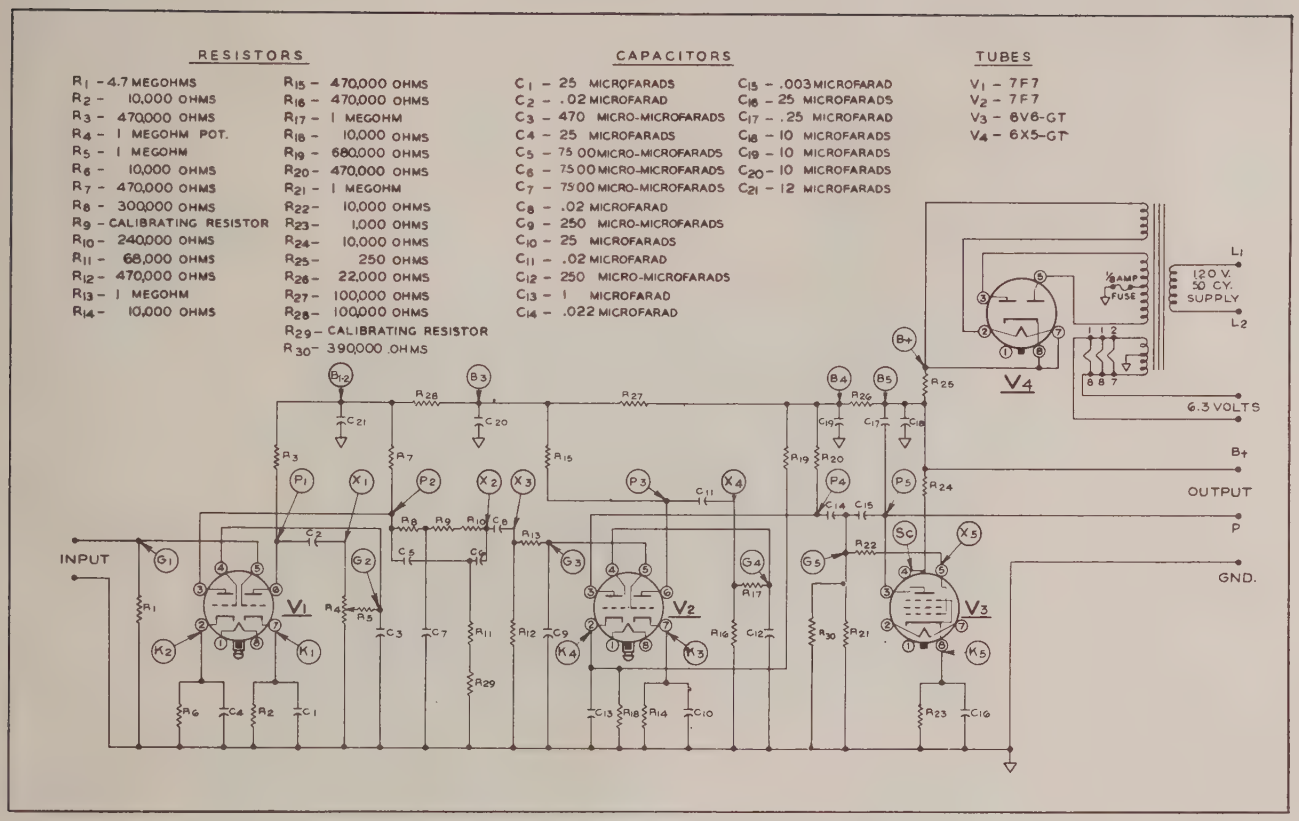


FIGURE 9. SCHEMATIC WIRING OF SERIES C-4 AMPLIFIER

The Bristol Company
Waterbury 20, Conn.

Printed in U.S.A.

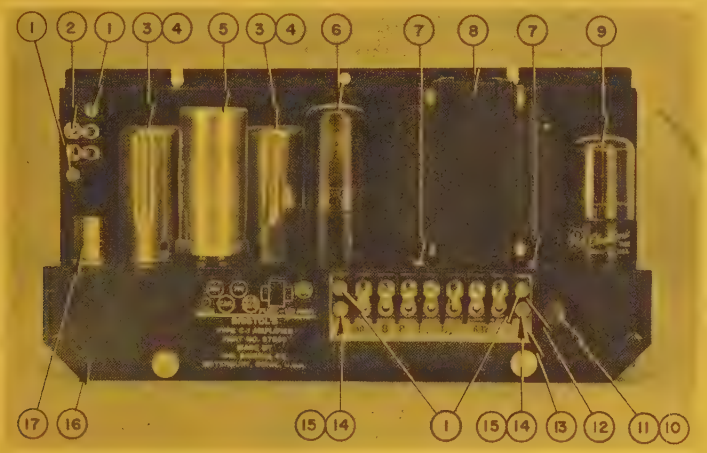
THE BRISTOL COMPANY
Waterbury 20, Connecticut., U.S.A.

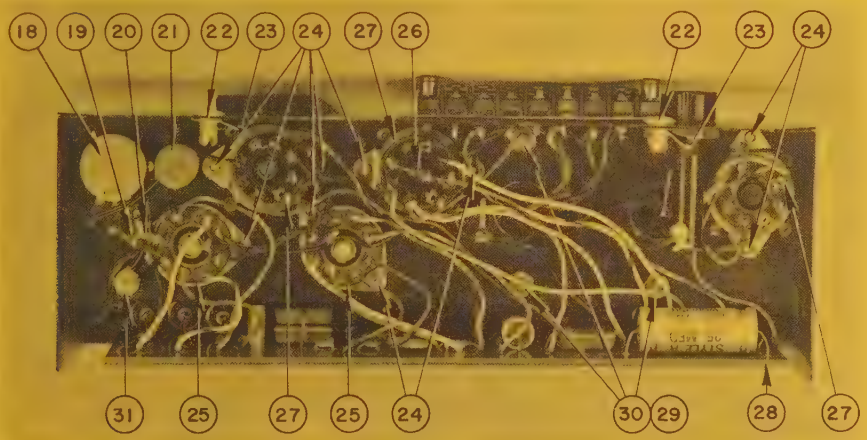
PARTS LIST
July 1963

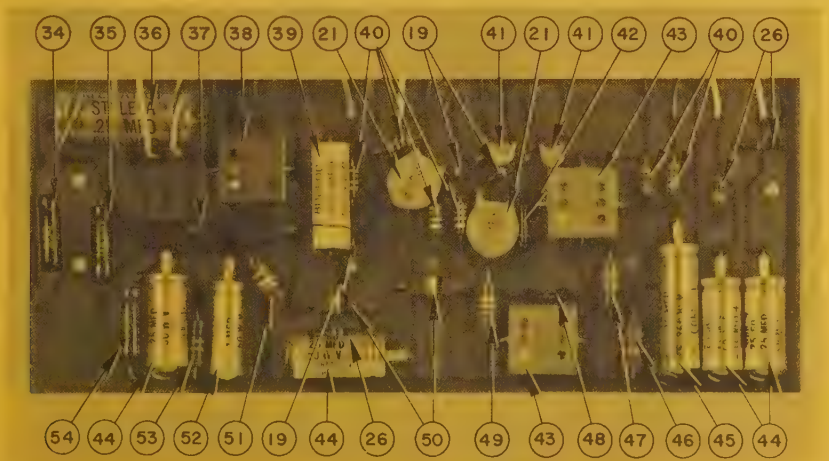
P12077

Replaces issue of 4/62

BRISTOL'S® AMPLIFIERS
SERIES C-1, C-3, C-4, D, D-2 & D-3
USED IN SERIES 560, 565 & 570 DYNAMASTERS





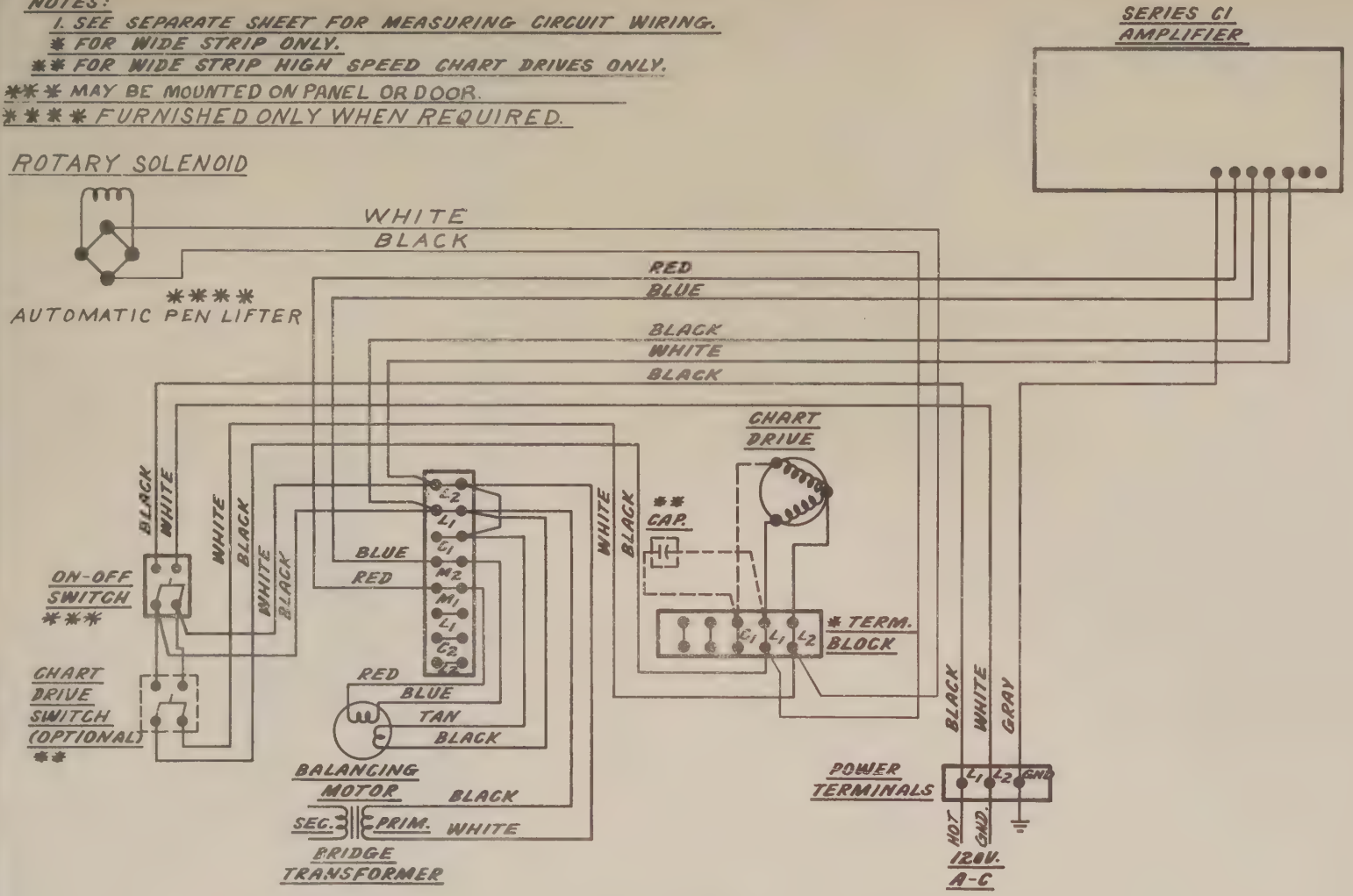


BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
	97600	Series C-1 Amplifier complete
	C1096	Series D Amplifier complete
1	86100	6-32 x 1/2" Self tapping screw
2	83987	Terminal Block (2-point)
3	91040	Tube shield
4	90596	7F7 Tube
5	83974	Capacitor
6	83972	6V6 - GT Tube for series C-1 amplifier
	A2236	5881 Tube for series D amplifier
7	40066	8-32 x 1/4" Fillister-head screw
8	90582	Transformer for series C-1 amplifier
	B1215	Transformer for series D amplifier
NOT SHOWN	A2240	Transformer mounting plate for series D amplifier
NOT SHOWN	A2238	8-32 x 5/8" Flat-head screw for above plate
NOT SHOWN	A2239	Spacer for above plate
9	90595	6X5 - GT Tube (for series C-1 amplifier)
	A4409	6AX5 - GT Tube (for series D amplifier)
10	84716	Fuse holder
11	64283	Fuse (1/8 amp Littlefuse)
12	90594	Terminal block (7-point)
NOT SHOWN	90636	Shield over 7-point terminal block
13	91946	Marking strip (7-point)
14	91136	6-32 x 3/4" Binding-head screw
15	45081	Collar
16	C1083	Chassis complete for series C-1 amplifier
	C1097	Chassis complete for series D amplifier
17	84549	Potentiometer shaft cap
18	A10979	Potentiometer (1 megohm ±10% tolerance)
19	83980	Resistor (1 megohm, 1/2 watt, ±10% tolerance)
20	83981	Resistor (4.7 megohm, 1/2 watt, ±10% tolerance)
21	A2182	Capacitor (ceramic) (.075 microfarad, 400 volt, ±5% tolerance)
22	89121	Dzus fastener
23	89122	Washer
24	92359	Eyelet for mounting tube sockets
25	90593	Loctal socket
26	72226	Resistor (10,000 ohm, 1/2 watt ±10% tolerance)
27	71708	Octal socket
28	97632	Printed circuit assembly complete for series C-1 amplifier (includes items 19, 21 and 34 thru 54)
	B1214	Printed circuit assembly complete for series D amplifier includes items 19, 21, 34 thru 50 and 52 thru 54.
29	35639	Lockwasher
30	26966	8-32 Hex nut
31	97630	Capacitor (ceramic) (470 micro microfarads ±10% tolerance)
34	97617	Resistor (250 ohm, 5 watt ±5% tolerance)
35	97619	Resistor (10,000 ohm, 5 watt ±5% tolerance)
36	97627	Capacitor (paper) (.25 microfarad, 600 volt, ±20% tolerance)
37	97620	Resistor (22,000 ohm, 10 watt ±5% tolerance)
38	97628	Capacitor (mica) (.003 microfarad, 500 volt, ±2% tolerance) for C-1 only.
39	97626	Capacitor (paper) (.022 microfarad, 600 volts ±10% tolerance)
40	83979	Resistor (470,000 ohm, 1/2 watt ±10% tolerance)
41	97629	Capacitor (ceramic) (250 micro microfarad, 1,000 volt, ±10% tolerance)
42	97684	Resistor (240,000 ohm, 1/2 watt ±1% tolerance)
43	90592	Capacitor (mica) (.0062 microfarad, 500 volt, ±5% tolerance)
44	97625	Capacitor (electrolytic) (25 microfarad, 50 volt -10% +150% tolerance)
	A7053	Capacitor (electrolytic) (50 microfarad, 50 volt -10% +150% tolerance) ("D" amplifiers only)
45	97624	Capacitor (electrolytic) (12 microfarad, 250 volt -10% +150% tolerance)
46		Calibrating Resistor
47	97683	Resistor (75,000 ohm, 1/2 watt ±1% tolerance) for C-1 amplifier
	89085	Resistor (68,000 ohm, 1 watt ±10% tolerance) for D amplifier
48	97685	Resistor (300,000 ohm, 1/2 watt ±1% tolerance)
49		Calibrating resistor (as required when parallel "T" is tuned)
50	87018	Resistor (100,000 ohm, 1 watt ±10% tolerance)
51	97622	Resistor (680,000 ohms, 1 watt ±5% tolerance) for C-1 amplifier only
52	97623	Capacitor (electrolytic) (1 microfarad, 50 volt -10% +150% tolerance) for C-1
	97625	Capacitor (electrolytic) (1 microfarad, 50 volt -10% +150% tolerance) for D
53	97621	Resistor (10,000 ohm, 1 watt, ±5% tolerance)
54	97618	Resistor (1,000 ohm, 5 watt, ±5% tolerance) for series C-1
	97617	Resistor (250 ohm, 5 watt, ±5% tolerance) for series D
		NOT SHOWN
	77982	6-32 x 3/16" Binding-head screw for mounting printed circuit board to chassis

PART NO.	DESCRIPTION
C1551	Series C-3 Amplifier complete
	Same as C-1 amplifier except for the following additions.
83980	Resistor 1.0 megohm 1/2 watt
A3636	Socket
94585	Decalcomania
C1646	Series C-4 Amplifier (50 cycle) complete
	Same as C-1 amplifier except for the following changes.
	Item 43 is changed to 93960
93960	.0075 microfarad capacitor
	Add to basic C-1 amplifier
A2812	Resistor 390,000 ohm
94585	Nameplate
C1552	Series D-2 Amplifier complete
	Same as D amplifier except for the following additions.
83980	Resistor 1.0 megohm 1/2 watt
A3636	Socket
94585	Decalcomania
C1650	Series D-3 Amplifier complete
	Same as D amplifier except for the following changes.
	Item 43 is changed to 93960
93960	.0075 microfarad capacitor
	Item 21 is changed to A2182
A2182	.075 microfarad capacitor
	Add to basic D amplifier
94585	Nameplate
AM125	Series C-6 Amplifier (50 cycle) complete
	Same as C-4 except for the following additions.
93980	Resistor 1.0 megohm 1/2 watt
A3636	Socket
94585	Decalcomania

NOTES:
1. SEE SEPARATE SHEET FOR MEASURING CIRCUIT WIRING.
* FOR WIDE STRIP ONLY.
** FOR WIDE STRIP HIGH SPEED CHART DRIVES ONLY.
*** MAY BE MOUNTED ON PANEL OR DOOR.
**** FURNISHED ONLY WHEN REQUIRED.



POWER CIRCUIT WIRING DIAGRAM
FOR SINGLE-POINT WIDE-STRIP OR ROUND-CHART DYNAMASTER A-C BRIDGE

TRACED 8-26-57

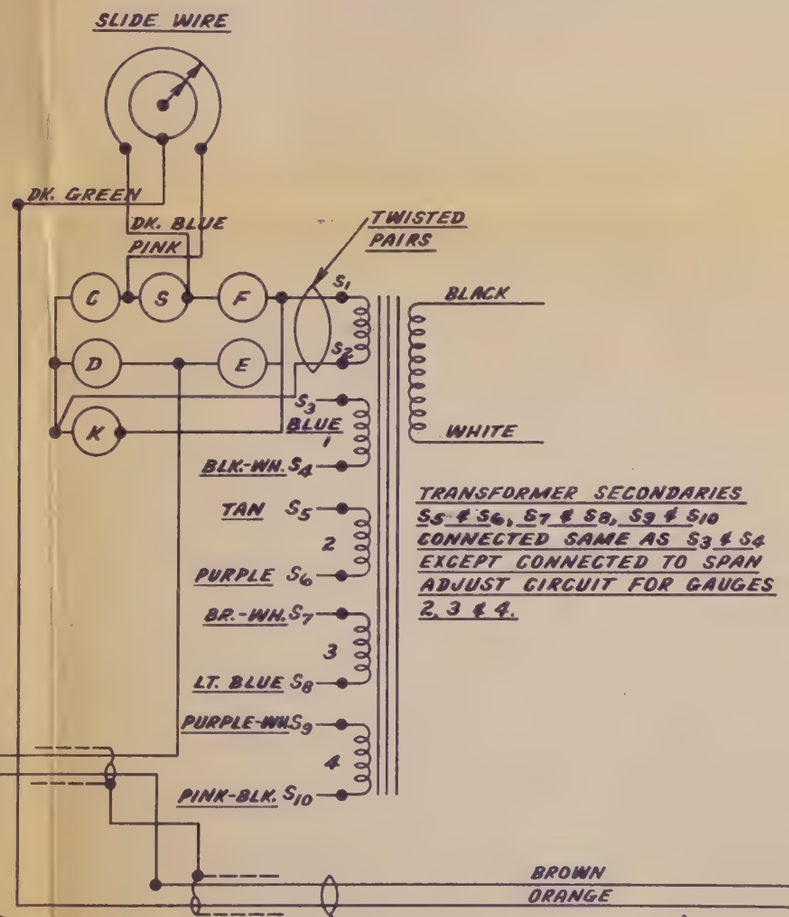
THE BRISTOL COMPANY
WATERBURY, CONN., U. S. A.
DRAWN H.R.S. TRACED B.F.H.
DATE 5-22-50 DRAWER NO. 122
SHEET NO. 011407-A-C1

REVISION DATES: 7-19-62; 2-26-59; 3-6-57; 11-2-55; 4-4-62; 11-9-56; 1-13-55

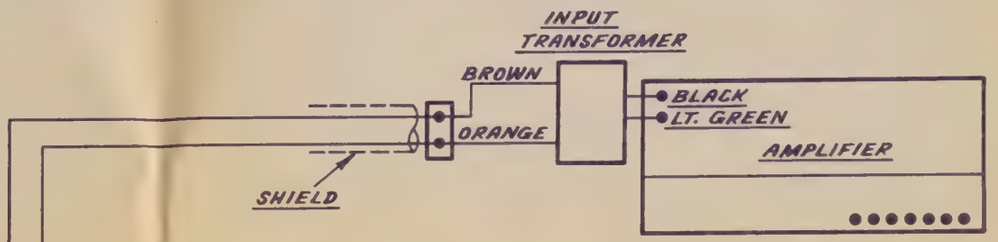
B CO. ORDER NO. CUSTOMER ORDER NO. SERIAL NO.

DEMAND NO. 93 142-

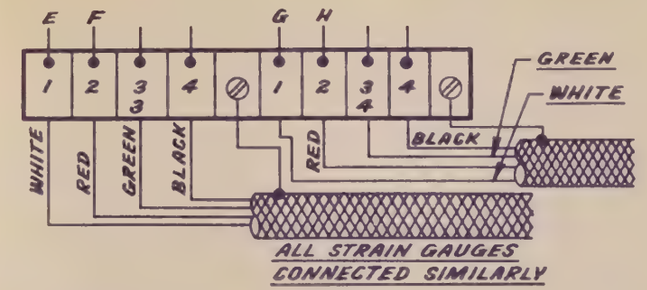
NOTE:
ALL SHIELDS CONNECT TOGETHER AND TO COMMON GROUND.

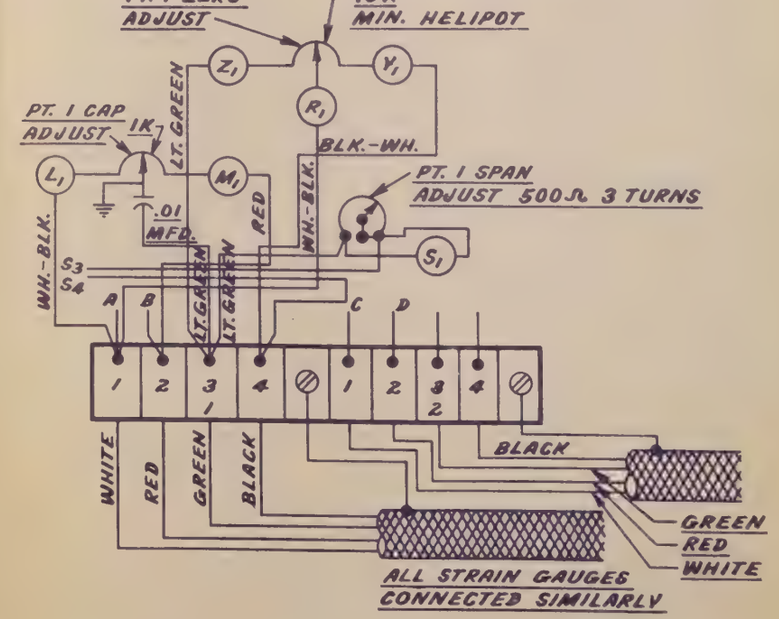


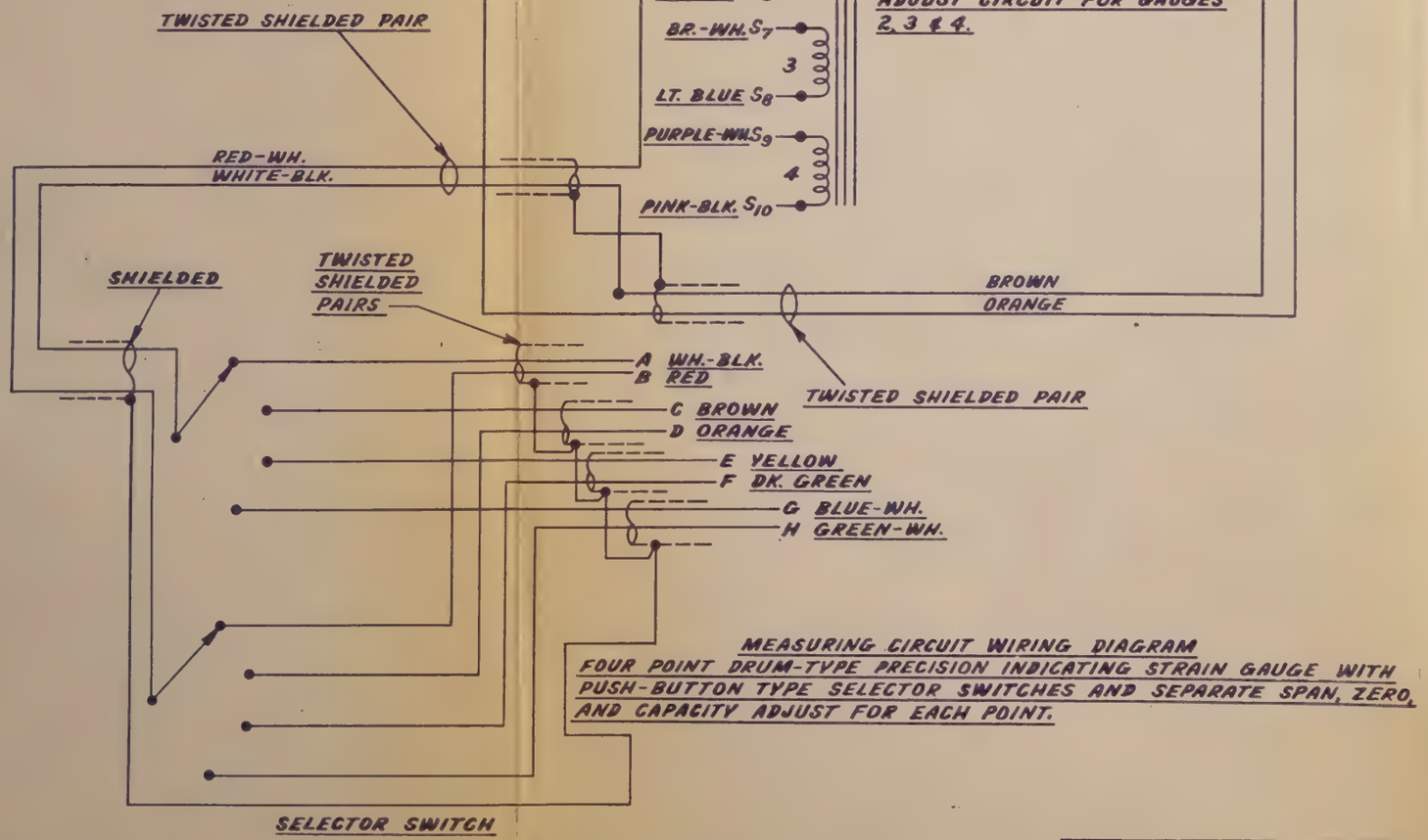
TRANSFORMER SECONDARIES S5 & S6, S7 & S8, S9 & S10 CONNECTED SAME AS S3 & S4 EXCEPT CONNECTED TO SPAN ADJUST CIRCUIT FOR GAUGES 2, 3 & 4.



SPAN, ZERO AND CAPACITY ADJUST POINTS 2, 3, & 4 ARE WIRED SIMILARLY.







MEASURING CIRCUIT WIRING DIAGRAM
FOUR POINT DRUM-TYPE PRECISION INDICATING STRAIN GAUGE WITH PUSH-BUTTON TYPE SELECTOR SWITCHES AND SEPARATE SPAN, ZERO, AND CAPACITY ADJUST FOR EACH POINT.

B. CO. ORDER NO. _____ CUSTOMER ORDER NO. _____ SERIAL NO. _____

				10-17-57	REVISION DATES

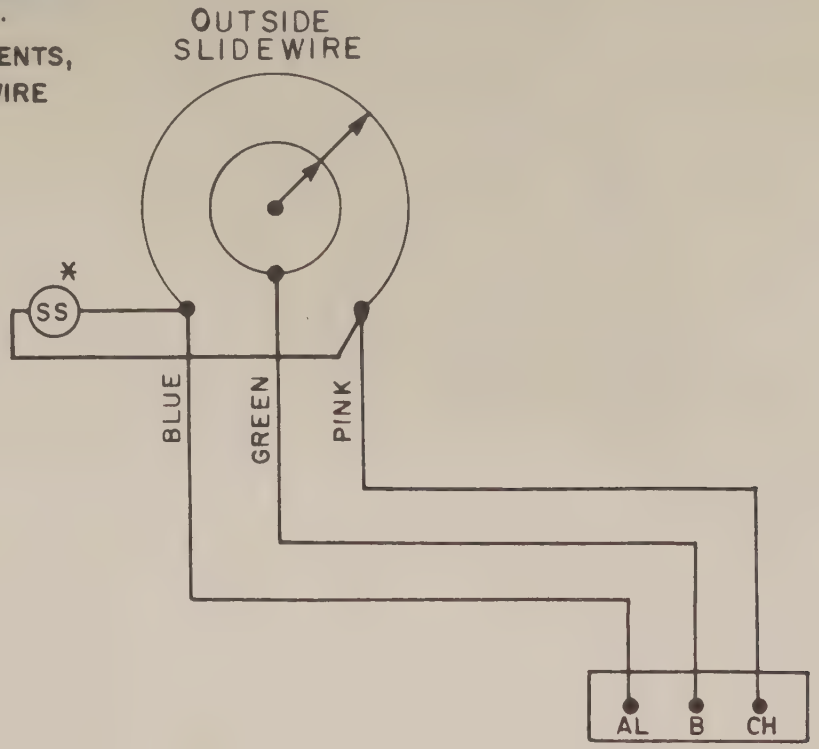
THE BRISTOL COMPANY
WATERBURY, CONN., U. S. A.

DRAWN B.F.H. TRACED _____
DATE 9-11-57 DRAWER NO. 221
SHEET NO. 016349

NOTE:

* SHUNT TO CHANGE RESISTANCE OF SLIDEWIRE TO VALUE DESIRED BY CUSTOMER AS & IF REQUIRED.

FOR REVERSE SCALE INSTRUMENTS, REVERSE THE PINK & BLUE WIRE AT TERMINAL BLOCK.



WIRING DIAGRAM

FOR AUXILIARY SLIDEWIRE USED ON DYNAMASTERS

RED. 10-8-63

DRAWN I.J.F.	DATE 3-26-53
TRACED	CHECKED / APPROVED
SCALE	FILE DR. 21
NO. 013839	

NO.	REVISIONS			
	10-4-63	6-9-54	4-13-53	
		5-12-55	6-25-53	

THE BRISTOL COMPANY
WATERBURY, CONN. U.S.A.

K&E 166 IMPERIAL TRACING CLOTH T.R. 64822

Instruction W-18220
Issued April 1954

HOW TO ORDER PARTS AND SUPPLIES

FOR BRISTOL PRODUCTS

In all correspondence concerning any product of the Bristol Company, always give the model and serial number of the product concerned. Send your purchase order or quotation request to the nearest Bristol Company Branch Office (see the back of this sheet for addresses).

REPLACEMENT PARTS

When ordering replacement parts look up the part name and number in the parts list provided with the instructions that came with your product. When you cannot find a part number, give an accurate description of the part. If you have mislaid your parts list write for a new one giving the model and serial number of the product.

CHARTS

In ordering charts for recorders, give the chart number (printed on the chart and also on the instrument name plate).

Avoid inconvenient emergency orders by keeping a six months supply of charts on hand for each of your recorders.

THERMOCOUPLES

Pyrometer thermocouples should be ordered from Bulletin P-1238. Be sure to specify the catalog number and the length. If you do not have Bulletin P-1238, write for one.

Pyrometer users should always have a supply of spare thermocouples.

SAMPLE PURCHASE ORDER:

QUANTITY REQUIRED	DESCRIPTION	PART, CHART OR CATALOG NUMBER
1000	Charts, 0° to 1500°F	5342
5	7-day electric chart drive for 115 volts, 60 cycles	86226
4	Pen arms marked CD	49703
1	Knurled plastic knob on outside of case, ½" diameter, 3/16" hole for moving set-point index	none given
1	1 oz. bottle red ink	6883
	The above parts are for a Bristol thermometer controller Model 1T1X500B-2, serial number 767211.	
4	IC thermocouples, length 30"	3BS14N2
	The above thermocouples are for a Bristol pyrometer Model 487-L, serial number 202953	

THE BRISTOL COMPANY

A Subsidiary of American Chain & Cable Company, Inc.

Waterbury, Conn. 06720

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Birmingham 35223, 14 Office Park Circle 871-6111

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Los Angeles 90022, 6800 East Acco Street 723-9751
San Diego 92115, 5606 El Cajon Boulevard ..... Juniper 3-2971
San Francisco 94107, 40 Berry Street ..... Garfield 1-0223

COLORADO
Denver 80216, 4555 East 46th Avenue 333-6228

CONNECTICUT
Hartford ..... Jackson 7-2377
Waterbury 06720, Bristol Road 756-4451

DELAWARE
Wilmington 19806, 2008½ Pennsylvania Avenue ..... Olympia 2-3166

DISTRICT OF COLUMBIA
Washington ..... Enterprise 1-5400

FLORIDA
St. Petersburg 33705, 945 Central Avenue 896-5151

GEORGIA
Atlanta 30305, 174 W. Wieuca Road N. E., Room 7 255-9436

ILLINOIS
Chicago Area, 2040 N. Hawthorne Avenue ..... Melrose Park **60160**
Chicago Phone ..... Estebrook 9-6800
Suburban ..... Murray 1-1450

INDIANA
Indianapolis 46205, P.O. Box 55294 Uptown Station ..... Walnut 4-1600

LOUISIANA
New Orleans 70112, 504 Delta Building 523-5522

MARYLAND
Baltimore 21214, 5439 Hartford Road, Room 101 ..... Hamilton 6-5766

MASSACHUSETTS
Boston 02116, Statler Building ..... Hubbard 2-1728
Hubbard 2-1729

MICHIGAN
Detroit 48238, 15769 Wyoming 864-4284

MINNESOTA
Minneapolis 55410, 7100 France Avenue South 920-3222

MISSOURI
Kansas City 64103, 1828 Walnut Street ..... Harrison 1-7301
St. Louis 63102, 818 Cotton Belt Building ..... Chestnut 1-7892

NEBRASKA
Omaha 68131, 33 Kiewit Plaza 341-8851

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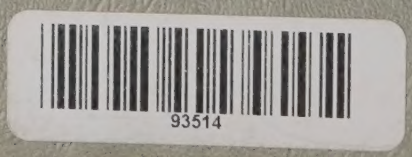
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